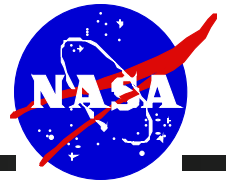
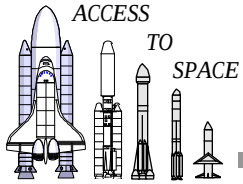




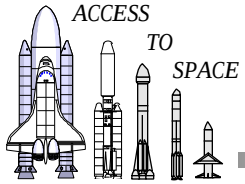
EXPLORER WORKSHOP

March 12, 2002

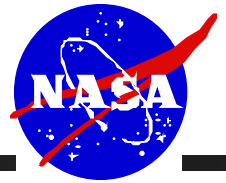
LAUNCH SERVICES

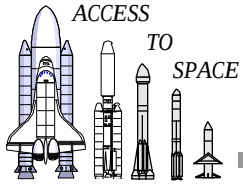
Karen Poniatowski
Deputy Associate Administrator
Space Access

Access to Space for Small Payloads



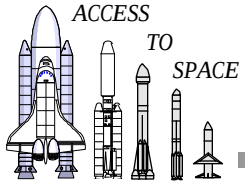
- OVERVIEW OF THE SPACE ACCESS OFFICE
- LAUNCH SERVICE CONSIDERATIONS FOR THE EXPLORERS PROGRAM
  - CONTRIBUTED LAUNCH SERVICES
  - NASA PROVIDED LAUNCH SERVICES
- MEETING FUTURE SPACE ACCESS REQUIREMENTS
- SUMMARY





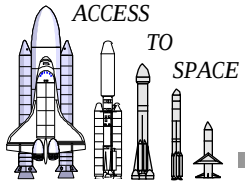
OVERVIEW OF THE SPACE ACCESS OFFICE

Space Access Office



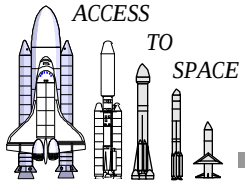
- The Space Access Office is Responsible for:
  - Identifying and aggregating Agency launch requirements
  - Integrating manifest process for both STS and ELV
  - Assuring access to space on all available launch systems, including the Shuttle, DOD, commercial launch vehicles or foreign vehicles
  - Acquisition and management oversight of the ELV Launch Services Program and the Payload Carriers Program

Space Access Office



- Space Access Management Approach:
  - Provide a Single Interface for Each Enterprise Payload Customer
  - Space Access issues and manifest conflicts (STS and ELV) identified and resolved through the NASA Flight Planning Board, chaired by the OSF DAA for Space Access
  - Effective October 1998 NASA consolidated responsibility for technical management and acquisition of ELV's for all NASA missions at the Kennedy Space Center (KSC)
  - KSC is the Lead Center for the Payload Carriers Program with supporting elements at Marshall Space Flight Center, Goddard Space Flight Center, and the Johnson Space Center

ELV & Payload Carriers Program Organization



NASA Enterprise Customers
Human Exploration & Development of Space
Space Science
Earth Science
Biological & Physical Research

NASA Spacecraft Programs

Office of Space Flight

Deputy AA Space Access

Flight Planning Board

Governing Program Management Council

HQ Safety & Mission Assurance

Lead Center Director

Safety, Health, & Independent Assessment

ELV & Payload Carriers Program Manager

Chief Financial Officer

Procurement Office

ELV Program Integration Office

Director ELV Launch Services

P/L Carriers Program Integration Office

MSFC Space Transportation Office

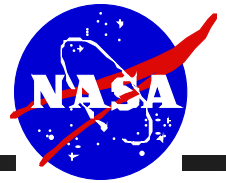
Mission Integration Teams

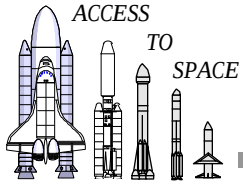
Mission Management Office

Safety & Flight Assurance Office

Vehicle Engineering Division

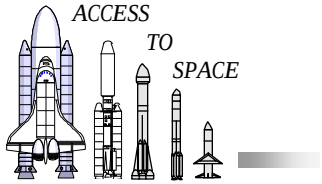
Launch Site Operations Division





Launch Considerations for Explorers Program

Explorers Program



University-class Explorers (UNEX)

- Space Science investigations characterized by definition, development, launch service, and mission operations and data analysis costs not to exceed $15.0M (real year dollars) total cost to NASA. UNEX missions may be launched by a variety of low cost methods.

Small Explorers (SMEX)

- Space Science investigations characterized by definition, development, launch service, and mission operations and data analysis costs not to exceed $75 million total cost to NASA. Estimated full launch service cost: $26M - $51M for a September 2004 launch*.

Medium-class Explorers (MIDEX)

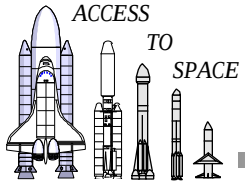
- Space Science investigations characterized by definition, development, launch service, and mission operations and data analysis costs not to exceed $150 million total cost to NASA. Estimated full launch service cost: $65M - $86M for a March 2007 launch*.

Missions of Opportunity

- Investigations characterized by being part of a non-NASA space mission of any size and having a total NASA cost of under $35 million. These missions are conducted on a no-exchange-of-funds basis with the organization sponsoring the mission. NASA intends to solicit proposals for Missions of Opportunity with each Announcement of Opportunity (AO) issued for UNEX, SMEX, and MIDEX investigations.

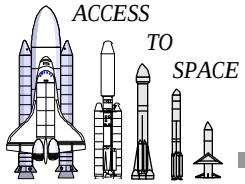
Note: Launch service cost ranges taken from respective Explorer program on-line AO libraries.

Contributed Launch Services



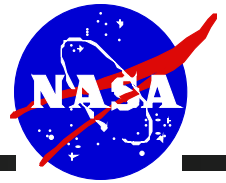
- Contributed Launch
  - The PI maintains responsibility to find an organization, other than NASA, that will contribute a launch.
  - Demonstrated reliability and resultant probability of mission success will be evaluated for all NASA provided and contributed launch services per NPD 8610.7, Launch Services Risk Mitigation Policy for NASA-Owned or NASA-Sponsored Payloads.

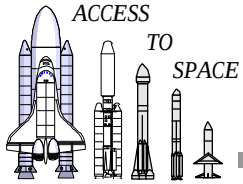
NASA Provided Launch Services



- Space Transportation System (STS)
  - NASA's Space Shuttle program. A payload can make use of the available cargo space on a Space Shuttle mission as a secondary payload as authorized by the Agency.

- Expendable Launch Vehicle (ELV) Launch Services
  - NASA provides commercial ELV launch services, whenever possible, for its scientific and application free-flyer missions. Launch services are provided for both dedicated and secondary flight opportunities.
    - Secondary payload customer responsible for recurring, integration costs and OSF responsible for non-recurring, developmental costs for secondary payloads adaptors.
    - Dedicated payload customers responsible for basic launch cost and any associated mission-unique non-recurring costs.

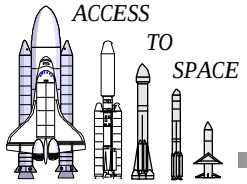




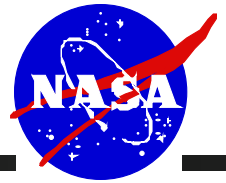
Shuttle Launch Opportunities

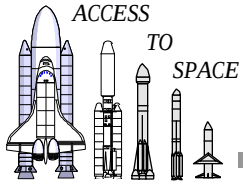
Secondary Payloads

Shuttle Launch Opportunities



- NASA Headquarters currently assessing the Space Shuttle use and prioritization process.
  - Transition to full cost will include customer assuming responsibility for funding STS integration costs.
- Current Shuttle flight rate constrained to 4/year
  - Bulk of Shuttle missions support ISS assembly
  - Backlog of existing secondary payload flight opportunities under review
- Competition for existing resources (lockers, mass, volume)
  - ISS mission elements (cargo elements, logistics, ORUs, payloads)
  - Shuttle secondary payloads backlog (mid-deck and cargo bay)
  - Commercial payloads, international partners, etc.
- Anticipate limited flight opportunities during ISS assembly phase
  - Currently not accepting new requests for Shuttle secondary opportunities pending review of existing backlog.

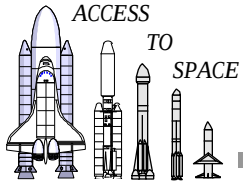




ELV Launch Opportunities

Dedicated and Secondary Payloads

ELV Launch Services



- NASA is required to acquire ELV launch services from U.S. commercial providers per current policy and law.
  - Commercial Space Act of 1998
    - Sect. 201, Requirement to procure commercial space transportation services.
    - Sect. 202, Acquisition of commercial space transportation services.
  - National Space Policy of 1996
    - U.S. Government agencies shall purchase commercially available space goods and services to the fullest extent feasible…
- ELV launch services for the NASA Explorers Program missions are primarily available through the NLS contract, and current and planned on-ramps.

SELVS-KSC Contract

- NASA Small ELV Services (SELVS-KSC) Contract
- SELVS-KSC Contract Award Date: October 1998
- Launch Service Providers
  - Orbital Science Corporation: Pegasus and Taurus
    - Pegasus on Contract: HESSI, GALEX, SCISAT, SOURCE, DART
    - Up to 11 launches and/or $400M contract value for launches ordered through October 2003.
  - Coleman Research Corporation: LK-0
    - No launches on contract.
- Current End of Ordering Period: October 2003
- Assuring Future Space Access
  - Evaluating block buy opportunities to assure space access through 2007 under current SELVS contract.

NLS Contract

ACCESS TO SPACE

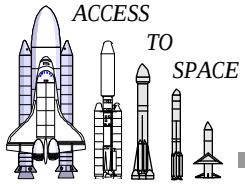
- NASA Launch Services (NLS) Contract
- NLS Contract Award Date: June 2000
- Launch Service Providers (Medium through Heavy-lift)
  - Boeing Delta Launch Services: Delta II, Delta III, Delta IV
    - Delta II firm missions on Contract: AURA, Deep Impact, Messenger
    - Options on Contract: MER B, SWIFT, and 3 available
  - Lockheed Martin: Atlas III, Atlas V
    - No missions on contract.
    - LMA withdrew offer for Athena services offered during August 2000 on-ramp.
- Up to 60 launch options possible under the indefinite delivery indefinite quantity portion of the contract
- Assuring Future Space Access
  - Evaluating block buy opportunities to assure space access on Delta II through 2007/2008.

NASA Small and Medium Class Launch Services

LAUNCH VEHICLE	PERFORMANCE, KGS (LBS)			
	LEO **200 km, i=28.5º**	**GTO** **36,000 km, i=28.5º** Per apogee altitude	**POLAR** **705 km, Sun Sync**	**PLANETARY** **C_3=0/10 km²/sec²** (kgs only)
Pegasus XL	440 (970)	*	210 (462)	*
Taurus				
2110	1370 (3020)	*	755 (1664)	*
2210	1150 (2535)	*	600 (1322)	*
2130	*	*	*	295 / 225
2230	*	*	*	245 / 185
Delta II				
2320-9.5	2780 (6128)	*	1715 (3780)	*
2320-10	2675 (5897)	*	1645 (3626)	*
2326-9.5	*	920 (2028)	*	625 / 490
2420-9.5	3185 (7021)	*	2065 (4552)	*
2420-10	3100 (6834)	*	1900 (4387)	*
2426-9.5	*	1130 (2491)	*	810 / 650
2920-9.5	5080 (11,199)	*	3270 (7208)	*
2920-10	4900 (10,802)	*	3170 (6988)	*
2925-9.5	*	1835 (4045)	*	1290 / 1050
2920H-9.5	6095 (13,436)	*	*	*
2925H-9.5	*	2170 (4783)	*	1525 / 1235

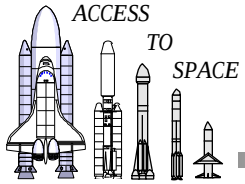
Performance data source: NASA KSC ELV Flight Design Group (http://elvperf.ksc.nasa.gov/)

How to Obtain NASA Provided ELV Launch Services for Dedicated Missions



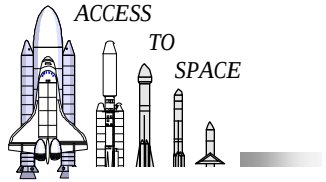
- Payload Enterprise AO
  - Proposals sought to meet scientific objectives of the Agency
  - AO provides guidelines for spacecraft and launch vehicle
- Payload Enterprise makes mission selection
- Payload Enterprise brings the new requirement to the Flight Planning Board
- The new requirement is approved by the Flight Planning Board
  - Mission Requirement
  - Launch Date
  - Launch Service Provider Assignment
- OSF provides direction to KSC to procure the launch service
- KSC acquires and manages the launch service

Secondary ELV Payload Options



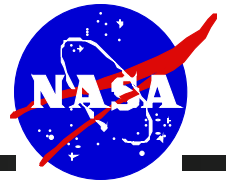
- Customer required to fund recurring integration costs within mission cost cap
- OSF plans to fund non-recurring development of adapters to enable secondary opportunities on Delta IV and Atlas V
- Nominal ordering period is 18 to 24 months depending on mission
  - Flight opportunities are uncertain at this time
- Secondary Payload (SP) Requirements
  - SP shall present no hazard (ordnance, radiation, contamination, etc) to the primary payload
  - Acceptance of the SP is subject to approval of the primary payload program manager
  - Primary payload orbit requirements and launch date shall not be affected by SPs
  - Approval of SPs will be considered only if sufficient performance margin exists for the primary mission. Approval could be withdrawn if the margin is unexpectedly reduced.

Launch Capability for Secondary ELV Payloads

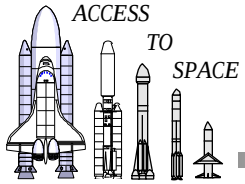


Existing Capability | *Future Capability*

	Pegasus	Taurus	Delta II Secondary	Delta IV/Atlas V Secondary
Mass	•DPAF 192 kgs (425 lbs) •3-point Load Bearing HW Based upon primary spacecraft and remaining launch vehicle performance.	•DPAF Based upon available excess performance. •APC – Aft P/L Capsule Based upon available excess performance.	•Typically 20 – 50 kgs (44 - 110 lbs), depending upon location of c.g. •P/Ls > 50 kgs evaluated on a case-by-case basis.	Up to 200 kgs (440 lbs) (TBD)
Volume	•DPAF Configuration 66cm (D) x 55cm (L) (26” (D) x 22” (L)) •3-Point Load Bearing HW Based upon dimensions of the primary spacecraft.	•DPAF 121cm (D) x 215cm (L) (48” (D) x 85” (L)) •APC 101cm (D) x 182cm (L) (40” (D) x 72” (L))	A variety of sizes and shapes accommodated; one dimension must be less than 31 cm (12 in) for separating payloads, and 38 cm (15 in) for non-separating.	76-cm cube (30” cube) (TBD)
Estimated Launch Service Cost	•With NASA Primary - $3M •With commercial - $11M •Additional HW Cost - $350K	NTE $20M**	Capability available under NLS. $2-3M.	TBD
Notes	•No secondary opportunities identified at this time.	**NASA has flown two secondary missions to date on commercial primary launches. ACRIM – 120 kg QuikTOMS – 375 kg	•Payloads are mounted at the Guidance section on the 2nd stage. •No opportunities identified at this time.	•NASA Atlas V and Delta IV secondary payload capability is under consideration.



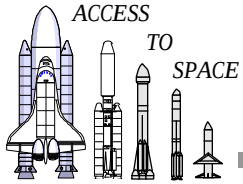
NASA Secondary Payloads



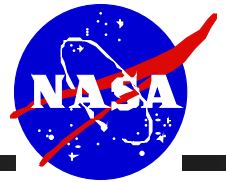
Mission	Mass	Date	Vehicle	Type
Flown To Date				
DUVE	102 kg	07/92	Delta II	2 Non Separating
SEDS-1	45 kg	03/93	Delta II	Tether
PMG	55 kg	06/93	Delta II	Tether + Diagnostics
SEDS-2	50 kg	03/94	Delta II	Tether
SURFSAT	35 kg	11/95	Delta II	2 Non Separating
SEDSAT	40 kg	10/98	Delta II	Separating
Orsted	61 kg	02/99	Delta II	Separating
Sunsat	63 kg	02/99	Delta II	Separating
ACRIM	120 kg	10/99	Taurus	DPAF
Munin	7.5 kg	11/00	Delta II	Non Separating
QuikTOMS	375 kg	09/01	Taurus	APC
StarShine 3	91 kg	09/01	Athena I	Separating
To Be Flown				
ProSEDS	105 kg	07/02	Delta II	Tether
CHIPSat	85kg	12/02	Delta II	Separating
ST-5	70kg	06/04	TBD	Separating

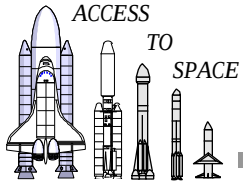
DPAF = Dual Payload Attach Fitting APC = Aft Payload Compartment

How to Obtain NASA Provided ELV Launch Services for Secondary Payloads



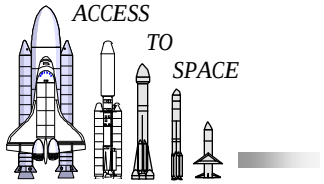
- Contact the KSC ELV Program Office, Darrell Foster (321) 476-3622 (http://elvperf.ksc.nasa.gov/contracts/secondary_payloads1.htm)
- Fill out Secondary Payload Questionnaire
- KSC provides OSF assessment of potential mission matches
  - Orbital and physical requirements
  - Launch schedules
  - Funding requirements
- OSF facilitates identification of an Enterprise sponsor:
  - Space Flight
  - Aerospace Technology
  - Earth Science
  - Space Science
  - Biological and Physical Research
- Funding source identified
- Compatible missions approved at the Flight Planning Board





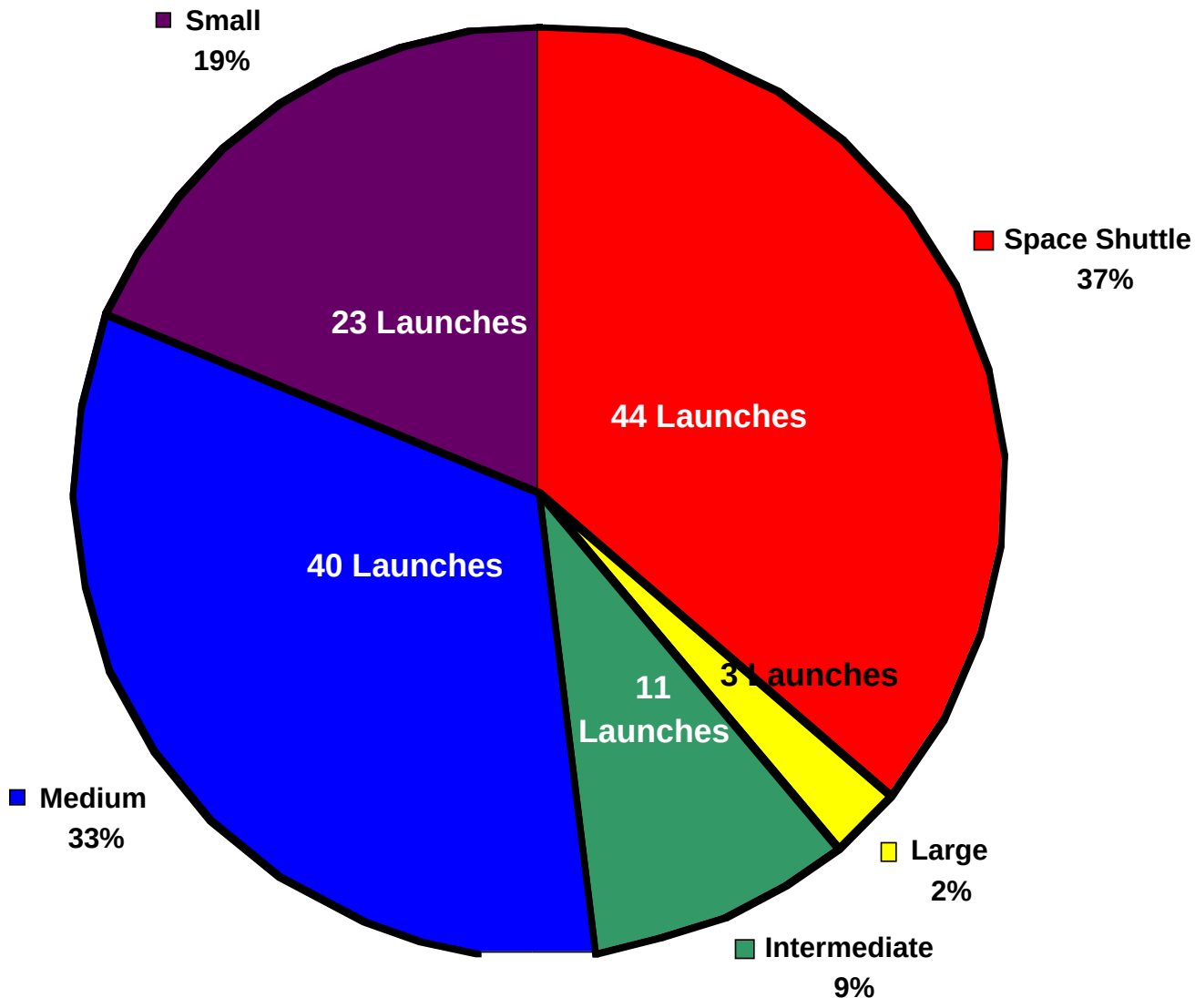
Meeting Future Space Access Requirements

Market Trends

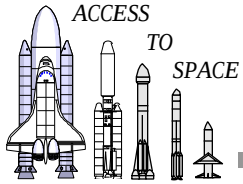


- The commercial and military launch service market trend is toward larger spacecraft requiring heavier lift capability.
- NASA is dominant user of small (Pegasus) and medium class (Delta II) performance range.
- Minimal launch industry interest in the secondary and/or dual-manifest payload opportunities.
- DoD Space Test Program (STP) and NASA share desire for reliable, low cost launch services for small-class payloads, science instruments, and technology demonstrations.

NASA 10 Year Aggregate Launch Requirements Forecast
Total ~ 121 Launches 2002-2011



Meeting Future Payload Space Access Requirements

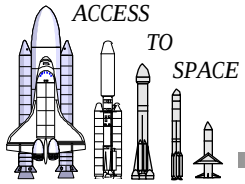


- In light of the current market trends, NASA science customers need to be assured of future space access capabilities for their small- and medium-class payload missions.

- OSF/KSC working to assure continued access to meet requirements.

- Other options for consideration on a case-by-case basis:
  - USAF Orbital Suborbital Program (OSP) Space Launch Vehicle (Minotaur)
  - Multiple manifest on Delta II
  - Available secondary payload volume on US launchers (Delta II/IV and Atlas III/V)

USAF OSP Space Launch Vehicle



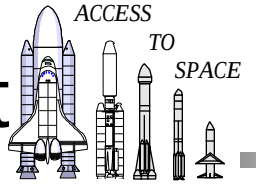
- USAF Orbital Sub-orbital Program (OSP)
- USAF OSP-II Contract Target Award Date: September 2002
  - Provide low cost, reliable space launch capability in support of U.S. government small-satellite launch requirements.
  - Contract Period of Performance: 10 years
  - Contract Options: Up to 20 missions (based on allotted MM-II's and Peacekeepers)
  - Small Launch Vehicle, Independent Verification & Validation, Range Support, Shipping, Program Management, Mission Integration & Design
  - Commercial Spaceports – WTR and ETR (minor infrastructure modifications required to support ETR launch requests)
  - Secretary of Defense approval authority for any orbital launch service.

- Estimate an 18-month mission integration cycle
- Estimated Cost of Launch Services: ~ $18 – 20M

Dual Ride Options

- Pegasus-XL, Taurus, and Delta II vehicles available
- Dual Payload Attach Fittings (DPAF) also available to fly secondary payloads
- Ordering period is 18 to 30 months depending on contract
- Mass capability
  - Approximately 150 kg (330 lbs) to 1360 kg (3000 lbs)
- Volume capability
  - Approximately 26” (D) x 22” (L) to 95” (D) x “70 (L) (66cm (D) x 55cm (L) to 241cm (D) x 177cm (L))

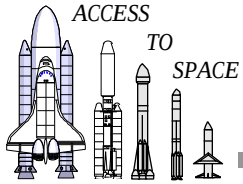
NASA Secondary Payload Effort



- NASA Secondary Payload Study
  - NASA Atlas V and/or Delta IV Secondary Payload Capability under consideration
  - Purpose: To assure long term capability for secondary payloads on future DoD, commercial, and NASA missions

- Awaiting industry identification of future flight opportunities.

Summary



- STS Secondary Launch Opportunities
  - Limited opportunities due to 4/year constraint.
  - For manifested secondary payloads, customer will be responsible for funding STS integration costs.
  - Future opportunities are under review

- ELV Launch Services
  - NASA provided ELV launch service options for Explorer missions primarily available through NLS, and current and planned on-ramp provisions.
  - OSF responsible for secondary payload non-recurring, developmental costs, and science customer responsible for recurring, integration costs.

- OSF continues to seek to meet NASA science customers' access to space requirements despite changing market conditions.